MISSION OPERATIONS AND COMMAND ASSURANCE: AUTOMATING AN OPERATIONS TQM TASK

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Mission Operations and Command Assurance (MO&CA) is a Total Quality Management (TQM) task on Jet Propulsion Laboratory (JPL) projects to instill quality into mission operations. The mission operations environment is inherently risky because each decision made is potentially mission critical. The flight operations environment generally requires operators to make rapid, critical decisions and solve problems based on limited information, while closely following standard procedures (Refs. 1-3). MO&CA's primary goal is to help improve the operational reliability and reduce risk of projects during flight, To achieve this goal, automation of the MO&CA task is required,

MO&CA specifically embodies the TQM principle of continuous process improvement (CPI) in which processes are constantly examined and analyzed for opportunities for improvement, Figure 1 shows how MO&CA implements CPI in two ways. First, within ongoing projects, the flight mission operations environment is established and MO&CA participates as a team member. In day-to-day operations, anomalies are documented as Incident Surprise Anomaly (ISA) reports. The ISAS then serve as data that is analyzed by MO&CA engineers for process improvement opportunities. When these opportunities are identified, MO&CA provides reports and data to support recommendations for improvement to project management. Finally, based on management approval, MO&CA helps the project implement the changes back into the day-to-day mission operations environment. This technique was successfully implemented on the Voyager (VGR), Magellan (MGN), TOPEX/POSEIDON, and Mars Observer (MO) projects.
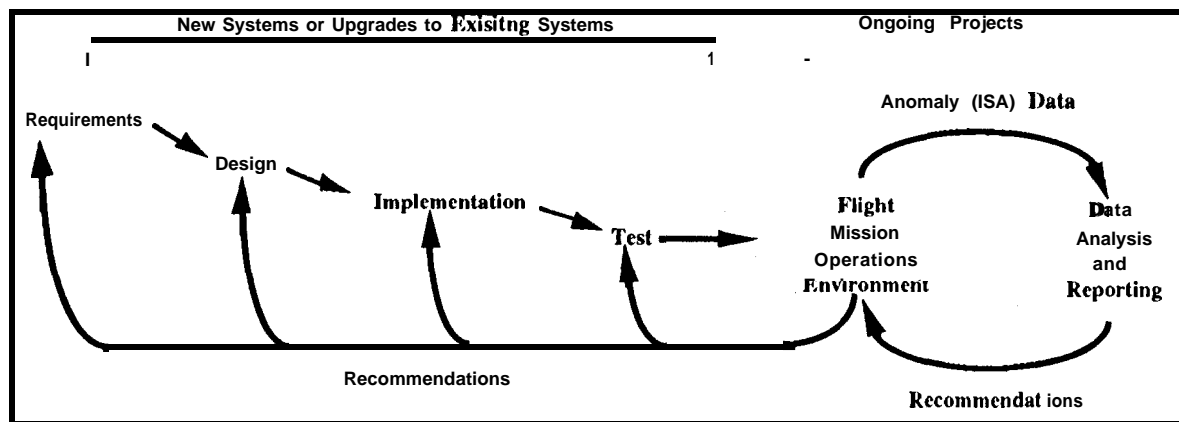

Figure 1

The second way in which MO&CA implements CPI on JPL projects is on new projects or upgrades to existing projects. The recommendations that are developed from the data analysis on ongoing projects are used as input to system requirements on new projects. This allows new projects to benefit from improvements made on past projects as TOPEX/POSEIDON and MO benefited from the experience gained on VGR and MGN.

For MO&CA to accomplish CPI on JPL projects, data must be collected, processed and analyzed in a timely manner. This requires automating the data collection and analysis functions. ISA reports are the primary data source for analysis of daily mission operations problems. This data is used daily by MO&CA managers and engineers. The ISA data is also used in a parallel error analysis study (Ref. 4). MO&CA's first automation effort was therefore to improve the usability and accessibility of ISA reports, An ISA database was initially developed for the MGN project. This database was expanded and utilized on the TOPEX/POSEIDON and MO projects. The ISA database is currently being incorporated into an on-line laboratory-wide problem failure reporting system.

MO&CA also analyzes command activity in parallel with ISA reports. This task was especially challenging for the TOPEX/POSEIDON project MO&CA team due to the volume of commands and the frequent changes associated with the Tracking and Data Relay Satellite (TDRS) communications system. Automating command data collection was therefore a necessity. Command collection automation enables the MO&CA team to anal yze transmission versus reception rapid] y to identify and correct errors.

While working with the command process, the TOPEX/POSEIDON MO&CA team noted the human intensive effort in command verification, A repetitive task such as command validation tends to be error prone and increase risk. The MO&CA team automated a portion of command checking which improved validation efficiency and reduced error probability.

In a similar effort for MO, MO&CA analyzed the data flow between operations teams during command development. MO&CA noted problems in the command design and command file development that lead teams to take shortcuts that subsequent y increased risk of error. MO&CA chaired a working committee that clearly defined the risk areas and developed solutions to correct the noted problems. A prototype of a command generation system to automate data transfer between teams and command form generation is under development.

With MO&CA's implementation of the CPI technique, not only do ongoing projects continuous y improve, but each new project starts with a better set of requirements and better developed processes than the last one. At JPL this continuous improvement feedback loop has improved flight mission operations processes from the Voyager Project, to the Magellan Project, and to the TOPEX/POSEIDON and Mars Observer projects. Additionally, this continuous process improvement reduces cost and risk of flight mission operations.

Future flight missions at JPL will have smaller spacecraft and flight teams (Refs. 5-6). Development times will be reduced and the teams that design and build the spacecraft will also staff the flight mission teams. Automation of data tracking and analysis by MO&CA helps to make operations process monitoring and error analysis more efficient and timely, With automation, MO&CA will be able to address problem areas quickly. This will streamline procedure development and eliminate late changes and upgrades thus reducing rework, cost, and risk,

Acknowledgment

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